

Docket No. SA-534
Exhibit No. 8-A

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C.

In-Line Inspection Tool Capabilities
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(9 Pages)

ILI Tool Capabilities

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NTSB pipeline hearing
March 3rd 2011
Washington DC



ILI is a process - not just about technology

Prove the pipeline is piggable



Pipeline Expertise

ILI Tool Run



Applied Physics



Carry out Mitigation Action



Carry out repairs)



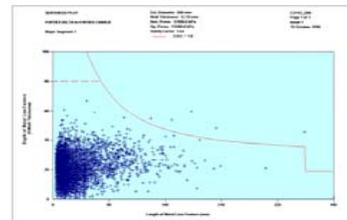
Carry out Report Validation (Confirm defect size)

NDE Expertise



Analyze the data & produce the inspection report

Analysis Algorithms

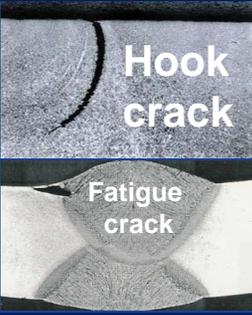
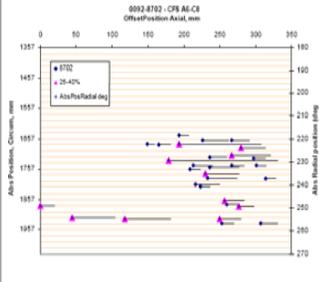


Integrity assessment and plan responses

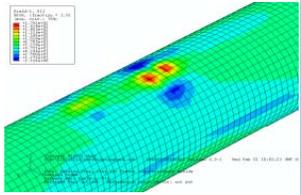
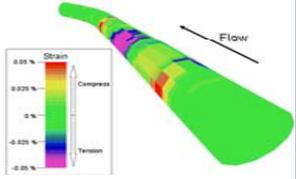
Engineering Expertise



Crack Inspection capabilities

Mission	Min detection	Enabling Technologies
<p>Identify and size significant cracks</p> 	<ul style="list-style-type: none"> liquids 0.040in deep and 1" long (USCD) In Gas 0.080in deep and 2in long (Emat) 25% wt deep and 2" long (TFI) 	 <p>Transverse field MFL (TFI Gas & Liquids)</p>
<p>Accurately locate and predict failure potential</p> 	<ul style="list-style-type: none"> +/- 3ft 3ins to weld +/- 8in along the pipe Use length and depth to prioritize 	 <p>Ultrasonic crack detection (USCD Liquids only)</p>  <p>Phased Arrays crack detection (USDuo liquids only)</p>
<p>Predict failure potential from adjacent cracks</p> 	<ul style="list-style-type: none"> Extensive SCC crack fields populated with both critical and subcritical cracks 	 <p>Emat Ultrasonic crack detection (Ematscan Gas & liquids)</p>

Corrosion and other inspection capabilities

Mission	Minimum detection	Enabling Technologies
<p>General Corrosion</p>  <p>Local Pitting</p> 	<ul style="list-style-type: none"> • 0.2in diameter • 5% wt for general corrosion • 10% wt for local pitting corrosion 	 <p>Ultrasonic Wall Measurement (USWM liquids only)</p>  <p>Corrosion + geometry combo (MFL Gas & Liquids)</p>
<p>Mechanical Damage</p> 	<ul style="list-style-type: none"> • 0.1 inch in depth • Dents & with metal loss signal in MFL combo 	<p>Transverse field MFL (TFI Gas & liquids)</p> 
<p>Map centerlines Detect wrinkles</p> 	<ul style="list-style-type: none"> • Positioning of Centerline - GPS • +/- 5ft • Bending Strain (pipe specific). 	<p>Geometry and Mapping (Caliper Geo gas & liquids)</p> 



Minimum defect sizes and tolerances

Typical Metal Loss (Corrosion) ILI tool specification								
Inspection Specifications	Axial Magnetic (Gas or Liquids)		Axial Magnetic (SHR) (Gas or Liquids)		Transverse Field Magnetic (TFI) (Gas or Liquids)		Wall Measurement Ultrasonic (USWM) (liquids only)	
	Pitting Corrosion	General Corrosion	Pitting Corrosion	General Corrosion	Pitting Corrosion	General Corrosion	Pitting Corrosion	General Corrosion
Min Detectable depth	10% wt	8% wt	8% wt	5% wt	40% wt	20% wt	0.040 inch	
Depth sizing tolerances	+/- 10% wt @ 80%		+/- 10% wt @ 90%		+/-15% wt @ 80%		+/-0.0197 in	+/- 0.04 in
Min detectable dia.	0.276 in		0.197 in		0.197 inch		0.393 in	
Probability Of Detection	90%		90%		90%		90%	
Probability Of Identification	80%		90%		80%		90%	

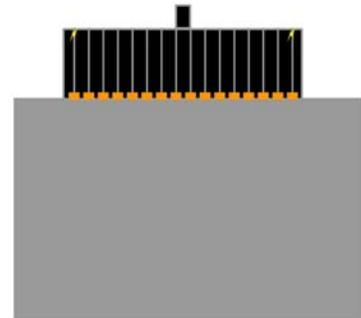
Typical Crack Inspection Tool specifications					
Inspection Specifications	Piezoelectric Ultrasonic (USCD) (for liquid pipelines)	Phased Arrays Ultrasonic (for liquid pipelines)	EMAT Ultrasonic for Gas (or Liquids)	Transverse Field Magnetic (for Gas or Liquids)	
				short	long
Min Detectable Crack Length	1 in	1 in	2 in	1 - 2 in	> 2 in
Min Detectable Crack Depth	0.04 in	0.04 in	0.08 in	50% wt	25% wt
Min Detectable Crack width	0.0 in	0.0 in	0.0 in	0.004 in	
Crack depth sizing tolerances	12.5% - 25% wt 25% - 40% wt > 40% wt	+/-0.04 in	12.5% - 25% wt 25% - 40% wt > 40%wt	+/- 25% wt	
Probability Of Detection	90%	90%	90%	80%	80%
Probability Of Identification	90%	90%	90%	30%	70%



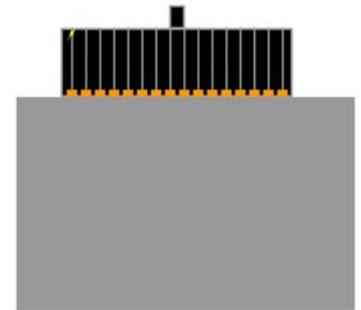
Tools have different specifications

Emerging technologies – Phased Arrays & Emat

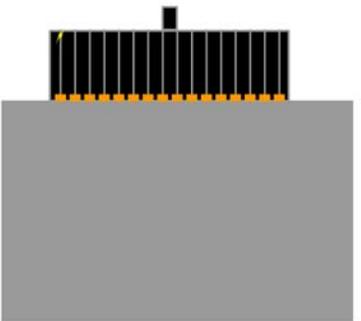
Phased Array Ultrasonic Inspection



Beam Focusing

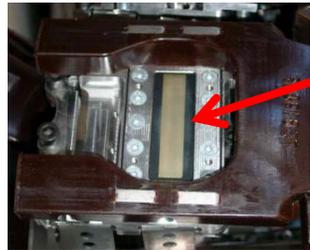


Beam Steering



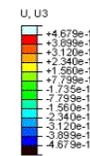
Beam Focusing and Steering

Provides many more sensing options



Phased array sensor in liquid pipelines

EMAT Ultrasonic Inspection

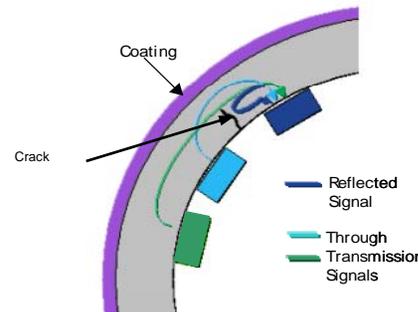


Transmitted Wave –
“Through Transmission”

Step: Step-1 Frame: 1

Reflected Wave
“Pulse Echo”

Axial Crack Flaw



eng
ard Time 2003

Electro Magnetic Acoustic Transducer

Generation of ultrasonic waves in the pipe wall by Electromagnetic pulses

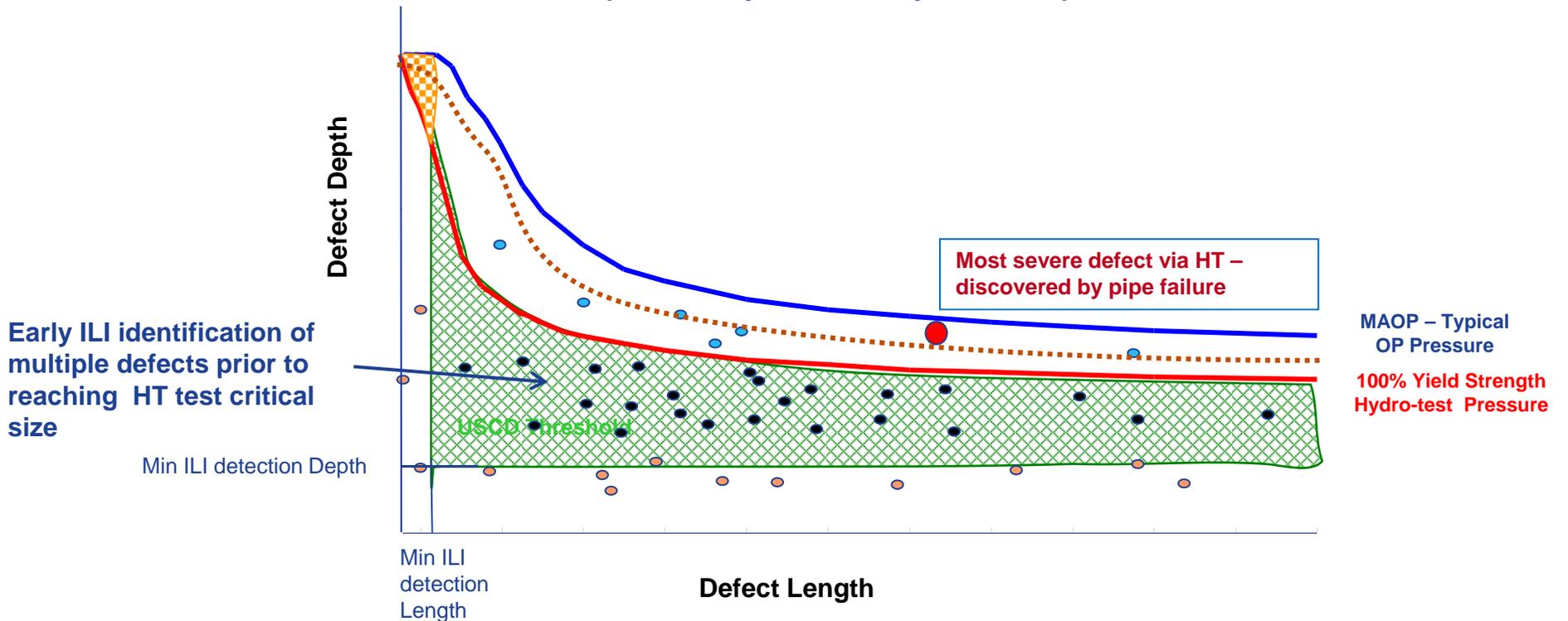
No liquid coupling required – Operates in Gas!

Discrimination of UT Reflector type crucial to characterization (Crack vs. Non-Crack)

Superior crack sizing capability for gas

ILI Capabilities vs. Hydro-test

A typical example of defects that can be monitored in a High Pressure Pipeline, using their length and depth, relative to the proximity of the Hydraulic pressure test failure curve.



ILI can provide early warnings of growth and increased confidence



NB. Diagram structure taken from IPC 2006 -10434 on Comparison of technologies for SCC threat validation and assessment

Back up Material

Time or Topic Permitting



Why are pipelines unpiggable?

